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Review

HOW to train for telephone-CPR

Tonje S. Birkenes [a, *], Helge Myklebust [a, 1], Camilla Hardeland [b, 2], Jo Kramer-Johansen [b, 2], Marcus Eng Hock Ong [c, 3], Sang Do Shin [d, 4], Micah Panczyk [e, 5], Bentley J. Bobrow [f, 6]

[a] *Laerdal Medical, Stavanger, Norway*
[b] *Norwegian National Advisory Unit on Prehospital Emergency Medicine (NAKOS), Oslo, Norway*
[c] *Singapore General Hospital, Singapore*
[d] *Seoul National University Hospital, Seoul, South Korea*
[e] *Arizona Department of Health Services, USA*
[f] *Arizona Emergency Medicine Research Center, Phoenix, AZ, USA*

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* Corresponding author. Laerdal Medical AS, Tanke Svilandsgate 30, N-4002, Stavanger, Norway.
E-mail address: tonje.birkenes@laerdal.no (T.S. Birkenes).
[1] Laerdal Medical AS, Tanke Svilandsgate 30, N-4002, Stavanger, Norway.
[2] Norwegian National Advisory Unit on Prehospital Emergency Medicine (NAKOS), Oslo University Hospital and University of Oslo, PO Box 4956, Nydalen, N-0424, Oslo, Norway.
[3] Department of Emergency Medicine, Singapore General Hospital, Duke-NUS Graduate Medical School, Singapore.
[4] Department of Emergency Medicine, Seoul National College of Medicine and Seoul National University Hospital, Seoul, South Korea.
[5] Arizona Department of Health Services, Bureau of EMS and Trauma System, Arizona, USA.
[6] Arizona Emergency Medicine Research Center, University of Arizona College of Medicine, Phoenix, Arizona, USA.

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1. Introduction

All age groups can suffer from cardiac arrest, but most victims are older than 50 [1,2]. Bystander cardiopulmonary resuscitation (CPR) has been shown to more than double the chance of survival from cardiac arrest, yet for multiple reasons the majority of victims do not receive any bystander CPR [2]. Enormous public CPR campaigns have yielded modest improvements and remain an inefficient mechanism to train the entire population [3,4]. Most cardiac arrests occur at home, where the bystander is likely a spouse, family member or a friend. In nine out of ten cases, the rescuer and the victim know each other [5] which may explain why bystanders often panic, feel insecure and are afraid to do anything wrong [6,7]. For the same reasons, only a minority of CPR trained bystanders actually start CPR by themselves [6,8]. With CPR instructions from a dispatcher over the telephone (T-CPR), the proportion of CPR among CPR-trained callers can triple and it can help many untrained callers to start CPR [8]. So regardless of prior training, T-CPR can increase bystander CPR [9–12].

Although a 2011 literature review found limited survival benefit from T-CPR [13], the 2012 American Heart Association (AHA) scientific statement said that T-CPR instructions can significantly strengthen the Chain of Survival and save lives from OHCA [14]. This survival benefit has later been confirmed in studies from Arizona, Seoul and Ishikawa [12,15,16]. A survival benefit has also been observed with increasing quality of bystander CPR [17–20], suggesting that the quality of T-CPR impacts outcomes.

After first being piloted by the Phoenix Fire Department, Arizona in 1974 [21], T-CPR was further developed in King County and Seattle, Washington [22] before spreading to other regions of the USA, Europe, and Asia. Some places use T-CPR mostly as just-in-time training for callers who have never previously learned CPR [23,24], while others use T-CPR instructions for both trained and untrained callers [10,25,26].

The purpose of this article is to review the published literature on T-CPR training and includes guidelines from 1966 to 2010 as well as current PubMed search results using: “CPR training”, “lay rescuer CPR”, “bystander cardiopulmonary resuscitation”,”Prearrival instructions”, ”Telephone-CPR″, “medical dispatcher”, “telephone-CPR”, “dispatcher-assisted CPR” as search words. Furthermore, we include implementation examples of T-CPR training for both dispatchers, call takers, and lay people.

The search was completed on July 28th 2015 with 5420 hits of which 223 titles described CPR training or CPR practice relevant for this review. Of these, 37 publications were further evaluated for T-CPR, of which eight specifically addressed T-CPR training.

1.1. T-CPR in international guidelines

Lay people have been encouraged to learn CPR since the first recommendations published in 1966, although these included only mouth-to-mouth in the beginning [27]. Evidence favoring the lifesaving effect of full CPR resulted in a recommendation to teach both ventilations and chest compressions to lay people in 1974 [28]. Despite massive public CPR training in Seattle and King County during the 70's, bystander CPR leveled out at 34% [29] before increasing to 56% following implementation of their T-CPR program in the early eighties [24]. As a result, the 1986 AHA Guidelines [30] recommended T-CPR, although this was not reflected in the CPR algorithm.

The 1992 guidelines acknowledged T-CPR instructions as a dispatcher responsibility, encouraging training in using T-CPR protocols [31]. The 2005 International Liaison Committee on Resuscitation (ILCOR) recommendations describe T-CPR as “reasonable”, with a neutral position on the survival effect [32]. Where the corresponding AHA guidelines encouraged T-CPR training for dispatchers [33], the European Resuscitation Council (ERC) guidelines came without any T-CPR recommendations [34].

In 2010, ILCOR recommended to include teaching of agonal gasping to lay people and that dispatchers should inquire about breathing and provide T-CPR instructions [35]. While the AHA guidelines recommend dispatchers to be educated in recognition of abnormal breathing, trained in providing T-CPR instructions and to instruct rescue breathings when asphyxiated cardiac arrest is suspected, the ERC guidelines recommended dispatchers just to be trained to interrogate callers according to strict protocols [36,37]. Both recommended chest compression-only for untrained callers, and no guidelines recommended T-CPR training for lay people. The 2012 AHA scientific statement is a guide for implementation with sample algorithm and pre-arrival instruction [14].

Neither ERC nor AHA algorithms currently reflect T-CPR. Instead, the algorithms continue to recommend someone other than the rescuer to call EMS, thereby preventing T-CPR for most rescuers.

1.2. Is T-CPR effective?

Before mobile phones and wireless telephones became widely used, callers would normally alternate between taking instructions over a landline phone and delivering CPR away from the phone. This was not very effective, and more compressions were delivered when callers brought the landline phone next to the victim [22]. Today, the ubiquitous nature of mobile phones allows nearly all callers to be next to the patient while speaking with the emergency medical center. By using the speaker function, the caller can communicate with the dispatcher while performing CPR on the patient [38].

The first step in T-CPR is to swiftly recognize cardiac arrest, which in some cases is not easy for the caller [39] nor the dispatcher [40,41]. Successful T-CPR also requires good communication between caller and dispatcher, which can be hindered by potential challenges like activating the speaker function and misunderstanding the instructions. Although agonal breathing is a significant challenge [42], T-CPR has shown to increase bystander CPR [8,11,12,15,16,42,43] and with a positive effect on the chance of survival [12,15,16,43].

Whereas most T-CPR protocols are designed to identify cardiac arrest, start CPR and maintain CPR until EMS personnel assume care, simulation studies have reported better CPR quality when T-CPR is delivered to CPR trained bystanders [38,44]. Other simulation studies report better performance with simplified instructions [45] and by using continuous T-CPR instructions [46].

This suggest that CPR training should incorporate the use of mobile phone and its speaker function, agonal breathing, recognition of cardiac arrest and continuous coaching to improve quality of CPR.

2. Before cardiac arrest – training for the real situation

In places where T-CPR is not yet implemented, it is logical to teach the public traditional patient assessment, getting help and how to perform CPR without telephone assistance. However, in places where T-CPR has been thoroughly implemented, it makes more sense to take a new approach, which is to teach T-CPR to both dispatchers and lay rescuers, as this will prepare them both for the real life situation.

2.1. T-CPR in lay people CPR training

There are few reports about incorporating T-CPR in lay people CPR training. The ongoing Pan Asian Resuscitation Outcomes Study

(PAROS) describes a community education program with T-CPR, including cardiac arrest recognition and CPR with dispatcher assistance, and how this can improve outcomes [47,48]. In a recent German observation study, no Basic Life Support (BLS) instructor addressed T-CPR in their classes, although T-CPR had been offered there since 2005 [49]. In Norway, a new 1-h T-CPR course has been developed for lay people where a dispatcher is the CPR instructor in video self-instruction, followed by role-play where the participants practice T-CPR in pairs and then have a debriefing [46]. The combination of this course with continuous T-CPR instructions resulted in better compression performance compared to traditional training and T-CPR [50], and confirms previous findings that T-CPR can improve quality of CPR also among trained bystanders [44].

T-CPR can assist a lay rescuer in numerous ways. The dispatcher can calm down panicked callers [51], give them a sense of not being alone [52]; many have expressed feelings of being supported both in real [53] and simulated cardiac arrest [54]. These observations have been validated in a community-based survey, where many respondents reported not feeling confident to do CPR [55].

When someone suddenly and unexpectedly collapses, the bystander frequently becomes stressed [6] and has a difficult time identifying cardiac arrest [39]. Many lay rescuers inaccurately believe the patient is either dead or alive and become confused about whether breathing is present, absent or abnormal. Lay rescuers are often afraid of hurting the patient and in their panicked state may not understand the instructions from a dispatcher. Not surprisingly, many lay rescuers refuse to follow the T-CPR instructions, which results in missed opportunities to save lives [41,42]. If cardiac arrest is not quickly and accurately identified by the dispatcher, CPR may not be performed and ambulance response will be delayed [39]. Signs of cardiac arrest and dispatcher instructions should therefore play a major part in CPR training for lay people. This was confirmed in a recent study from Denmark, where cardiac arrest bystanders addressed major gaps between their expectations and the actual experience: BLS courses were too superficial and lacking preparation for the real situation, and the questions and instructions from the dispatcher confused them [52].

2.2. T-CPR in dispatcher training

Recognizing cardiac arrest, getting T-CPR started and sustained over the phone is simple but not easy. A review study from three U.S cities reported only 15% delivery of T-CPR, despite successful recognition of cardiac arrest and available T-CPR instructions [51]. In contrast, Seattle reported T-CPR delivery in 62% of eligible cases [56]. In the latter case, the dispatchers had attended a 6 h course dedicated to the recognition of cardiac arrest and delivery of T-CPR instructions [56]. In a review of 100 audio recordings of cardiac arrest calls from Gothenburg, T-CPR was only attempted in 11 cases, and the major obstacle was the presence of agonal breathing, which confused the dispatchers [57]. An intervention including 1-day training in recognition of agonal breathing among Stockholm's dispatchers increased T-CPR delivery from 47% to 68% [58]. Similarly, T-CPR increased from 41% to 56% in Japan following a continuous quality improvement project with simulation training for dispatchers [12].

Analysis of T-CPR calls in Edinburgh looked at time usage and communication needed to progress through key stages of their Medical Priority Dispatch System (MPDS) protocol. Most of the time and communication delays were related to breathing assessment and CPR instructions, and the authors suggest this should be more targeted in training [59].

As part of continuous quality improvement, King County EMS (Washington) [56,60] and the SHARE program (Arizona) [61] have developed two different e-learning courses for dispatchers focusing on recognition of cardiac arrest and assertive provision of T-CPR instructions. The latter is available in ten languages, and is used by PAROS members [47,48,62]. A recent study from Arizona combined the SHARE e-learning with a half-day face-to-face course. This was bundled with a two-question T-CPR protocol, performance measurement and feedback to dispatchers. The reported survival increased from 8.3% to 11% [15].

As for bystanders, dispatcher training should focus on recognizing cardiac arrest and delivering CPR instructions. Dispatchers should also recognize the importance of continuous coaching and encouragement on chest compression quality [46,63].

2.3. T-CPR in public campaigns

A popular US television show during the 80s and 90's was called “Rescue 9-1-1”. Broadcasted to millions of Americans and viewers in 45 countries, it highlighted the importance of the 911 call taker and T-CPR [64]. A US survey from 2000 concluded that lay people expect instructions when calling 911, although this service may not be implemented for all [65].

Information about CPR to the lay public can lead to an increase in bystander CPR [66] and some campaigns are promoting T-CPR to increase bystander CPR. One example is the Danish “Du kan redde liv” (You can save lives) campaign, hosted by Trygfonden. Their ambition is to increase bystander CPR from 64% to 85% [67]. Another example is the SHARE program, which promote T-CPR in public service announcements in Arizona [68].

3. During cardiac arrest – optimizing caller-dispatcher teamwork

T-CPR can be seen as just-in-time training for the untrained rescuer as well as refresher training for the trained bystander. In places with T-CPR, dispatchers consider patient treatment as their responsibility until ambulance personnel take over. This responsibility is easier to carry when the caller has previous CPR training, has the phone next to the patient and uses the phone speaker function. Then caller and dispatcher can complement each other. The dispatcher being the professional, current with the latest guidelines whereas the caller has the hands that do the job. Together they are the first team to help the patient.

Although there are no clinical studies about quality effects of T-CPR, Kuisma found better survival when dispatchers handled more T-CPR cases. In order to keep survival optimal, each individual dispatchers should handle 8–16 cardiac arrest calls per year and part time workers need special attention and support from their supervisors and educators [40].

A Swedish study looked at how dispatchers perceive their T-CPR experience. Being supportive, relieving the caller of the burden of responsibility, and connecting with them mentally to enable them to act, were among the findings. The study also found large differences among dispatcher's feeling of competency and preference to give T-CPR instructions, in particular to elderly callers. Most importantly, dispatcher competency depends both on retraining and feedback about patient outcome [69].

4. After cardiac arrest

Debriefing of simulated and real cardiac arrest is recommended to help improve both team and individual performance [36]. Post-event evaluation is used systematically in places like Seattle [56] Arizona [15] and within PAROS [48] and includes a review of audio files from cardiac arrest and performance measurement. Møller found that debriefing of bystanders had a positive effect on their ability to cope with emotional reactions and increased

confidence to perform CPR in the future [52] and might address the desire for health care follow-up identified among bystanders interviewed in Norway [70].

5. International experiences

5.1. The Oslo experience

In Norway the public calls the nearest of 18 Emergency Medical Dispatch using a 3-digit telephone number (1-1-3). EMD-operators in Norway are either nurses or paramedics with additional training in the use of the decision support tool – Norwegian index for acute medicine (NI) [71]. T-CPR was part of NI from the very start (1994) focusing on commencing chest compressions. The assumption was that the phone and the victim could be in different places so the caller would have to receive instructions, go to the victim, perform as instructed, and return to the phone for further guidance.

Training in T-CPR for operators has been a local responsibility and integrated with training in the use of NI. Observational studies of call handling in cardiac arrest in Oslo/Akershus Emergency Medical Dispatch (OAEMD) [72], led to a research project with observations and qualitative studies of the operators and an intervention including education as well as individual feedback to improve recognition of cardiac arrest and initiation of T-CPR including continuous instructions.

Norwegian courses in CPR are based on Norwegian Resuscitation Council recommendations. Neither has included the use of telephones to receive CPR instructions. However, instructors may have included such information in their teaching at their own discretion. In 2009 we started developing and testing new CPR training for elderly lay people, and in this training we included the use of a telephone loud speaker and emphasized the usefulness of continuous telephone instructions and support [46]. More than 5000 persons have been trained as part of development and testing, and from 2013 the Norwegian Association of Heart and Lung Patients introduced the new training into their organization, offering the courses free of charge for their members.

Since systematic training of both operators and lay people has just started, it's too early to make any conclusions about its effects on cardiac arrest survival. All cardiac arrests are reportable to the Norwegian Cardiac Arrest Registry, and regional differences in T-CPR and outcome will become apparent. The upcoming revision of NI is expected to further emphasize T-CPR in accordance with presumed changes in international recommendations.

5.2. The Singapore experience

Singapore started introducing T-CPR in January 2012 as part of a larger interventional trial in the PAROS countries [48], comprising:

1. A standardized dispatch protocol to help dispatchers identify cardiac arrest.
2. A training package for dispatchers to give CPR instructions over the telephone in a confident and assertive manner.
3. A standardized measurement tool to collect data on individual dispatcher and organizational-level performance through review of the dispatch audio recordings.
4. An integrated quality improvement program that provides feedback at the individual and organizational level.
5. A community education program to update the public on DACPR.

Dispatchers in Singapore are usually fire fighters (some paramedics and nurses). They all undergo standardized training with their computer aid protocol system. In addition, they undergo the PAROS DA-CPR one day face-to-face training which includes cognitive sessions, simulation, as well as an online self-learning DA-CPR package. We also do 100% quality improvement review of audio recordings of cardiac arrest calls, with weekly education and feedback rounds conducted for the dispatchers by the medical director and dispatch nurses.

In 2014, the Dispatcher Assisted first Responder (DARE) program was launched as a community-based education program focused on dispatcher-assisted CPR and AED use. It focuses on training laypersons to call 995, commence chest compressions while being coached by an EMS dispatcher, and the use of an AED, if available. As of May 2015, more than 5000 laypersons have been trained by DARE, with an intention to scale up to one million people over the next five years.

A before-after analysis was conducted using OHCA cases retrieved from the national OHCA registry and T-CPR information from audio recordings, ambulance documents and medical records. Data was collected before the intervention, during the run-in period and after the intervention. A total of 2968 cases were included. Bystander CPR rate increased from 22.4% to 42.1% ($p < 0.001$) and ROSC increased significantly from 26.5% to 31.2% ($p = 0.022$) [73].

Future plans include a large population-based study that intends to measure the impact of a bundle of community interventions implemented in a specific geographical area of Singapore on the survival rates for OHCA. The bundle includes training 50,000 community first responders (on CPR and PAD), installing automated external defibrillators (AEDs) at residential housing blocks, linking first responder volunteers to EMS using a 995 first-responder app and improving CPR quality using a novel CPR feedback card.

5.3. The Arizona experience

The Save Hearts in Arizona Registry and Education (SHARE) Program initiated a formal T-CPR program at 911 dispatch centers across the state in 2011. This included:

1. Standardized live and web-based video trainings.
2. Implementation of guideline-based protocols.
3. System and case-level feedback to individual providers for quality-improvement.

Dispatchers are trained in three “phases” of T-CPR.

1. Identification: Dispatchers are trained to assertively control calls, press standardized questions, and start CPR instructions as soon as possible. They are trained to recognize agonal breathing and caller descriptions of agonal breathing.
2. CPR Instructions: Dispatchers are trained to direct callers to start compression-only CPR as soon as possible. Callers often object that they might hurt the person. Training emphasizes that CPR is safe and urges dispatchers to persist in initiating bystander CPR.
3. Coaching: Dispatchers remain on the phone until EMS arrives, directing callers to count out compressions so dispatchers can monitor and speed the compression rate if needed.

A continuous public outreach campaign, in conjunction with a formal T-CPR program, put bystander CPR rates above 50% in 2013 [15]. A recent outreach tool, a public service announcement and CPR information banner highlighting the importance of teamwork between OHCA callers and dispatchers, yielded 4.9 million online impressions in 2014.

An evaluation of 1232 pre-implementation and 1300 post-implementation suspected OHCA calls showed an increase in the

rate of T-CPR from 44% to 62% and a decrease in median time to first chest compression from 178 s to 155 s [15].

SHARE aims to more deeply integrate community and dispatch CPR training. SHARE also aims to integrate real-time feedback mechanisms to improve bystander CPR quality and to cite AED locations in dispatch CADs.

5.4. The Seoul experience

Seoul Metropolitan Fire Department (SMFD) started the T-CPR program in 2011, expanding to the whole country in 2012. A novel protocol with two key questions for detection of OHCA and compression-only CPR instructions was implemented. T-CPR education and quality assurance programs developed by PAROS and partners were initiated by each provincial Fire Department [46,48,61,74].

As in Singapore, the T-CPR education program included didactic sessions, interactive skill sessions and feedback. More than 90% of the dispatchers completed this training in 2011. Post training, all dispatchers completed a web-based, self-learning program [75]. All new dispatchers are trained with the same education program.

An electronic T-CPR registry was developed and implemented in all dispatch centers, and potential OHCA cases were recorded. This registry was also used for the quality assurance program, where the medical director at each dispatch center was encouraged to manually review at least 10% of all T-CPR audio recordings and provide regular feedback to the dispatchers [48]. In addition, senior supervisors were encouraged to review the CPR registry to increase the detection rate of OHCA, reduce protocol violations, and maintain the quality of T-CPR processes.

A new T-CPR training for lay people was incorporated in community programs in 2015. Duration is one hour and includes video-based T-CPR training, a short role-play and debriefing [46]. It is initially implemented in four Seoul counties covering a population of two million. The target is to reach 75% of all trainees with this new training, of which half should be elderly and women. The goal is to improve compliance with our T-CPR instructions and to improve quality of home bystander CPR (Home Education and Resuscitation Outcomes Study, HEROS phase 1 study). The HEROS consortium is led by Seoul Metropolitan Health Department, Hospitals, training organizations, local health authorizes, medical directors, and SMFD.

The Korea Centers for Disease Control and Prevention register outcome on all cardiac arrest patients transported to hospitals. If the HEROS study phase 1 show improved outcome, the program will be expanded to the whole city of Seoul.

6. Limitations

Despite decades of T-CPR practice, little had been published regarding T-CPR training for dispatchers and lay people. What to train, how to train and how to maintain competency over time should be further investigated and optimized.

7. Summary and conclusion

Early adopters of T-CPR take a holistic approach: After having developed a local protocol, dispatchers are trained to be assertive, to recognize cardiac arrest and to give continuous coaching on CPR quality until ambulance arrives. They use a systematic review of audio recordings with feedback to each dispatcher to improve performance. Public awareness campaigns and T-CPR training to the lay public is used to improve preparedness of the first resuscitation team. With careful and measured training of dispatchers and the lay public to overcome barriers, T-CPR has the potential to substantially improve CPR delivery before ambulance arrival and save more lives than ever.

Conflict of interest

Tonje S. Birkenes and Helge Myklebust are employees of Laerdal Medical, Stavanger, Norway.

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